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## Results of the Puritan-American Museum of Natural History Expedition to Western Mexico

### 20. The Recent Mollusks: Gastropoda: Harpidae, Vasidae, and Volutidae

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#### INTRODUCTION

The present paper continues a study of the Recent marine mollusks collected in west Mexican waters during the course of the expedition. Previous reports considered the family Conidae (Emerson and Old, 1962), the superfamily Cypraeacea (Emerson and Old, 1963a), and the superfamilies Strombacea, Tonnacea, and Cymatiacea (Emerson and Old, 1963b). The present report treats the gastropod families Harpidae, Vasidae, and Volutidae.

Specimens were taken by shore and intertidal collecting, by skin diving, and by dredging from a small skiff and from the schooner "Puritan." Dredging operations were restricted to depths no greater than 50 fathoms. The itinerary and descriptions of the collecting stations were recorded in the general account of the expedition (Emerson, 1958).

The present collection contains three of the four eastern Pacific species that represent the families covered by this paper. An attempt is made to

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determine for the west Mexican region the modern and fossil distributions of these species. A new species of *Vasum* is described from the Pliocene deposits of the Imperial formation of Imperial County, California.

I am indebted to several people for assistance in the completion of this report. Dr. R. Tucker Abbott of the Academy of Natural Sciences of Philadelphia; Dr. Harald A. Rehder of the United States National Museum, Smithsonian Institution; Dr. Wendell P. Woodring and Mr. Druid Wilson of the United States Geological Survey, Washington, D. C.; Drs. G Dallas Hanna and Leo George Hertlein of the California Academy of Sciences, San Francisco; Mr. Thomas L. McGinty of Boynton, Florida; Mr. A. A. Olsson of Coral Gables, Florida; Dr. Katherine van W. Palmer of the Paleontological Research Institute of Ithaca, New York; and Dr. J. Wyatt Durham and Mr. Joseph H. Peck, Jr., Museum of Paleontology, University of California, Berkeley, generously permitted access to the collections of their respective institutions, provided specimens on loan, or gave helpful information. Mr. and Mrs. Harry I. Johnstone of Mobile, Alabama; Mr. and Mrs. Leon Pequignot of Akron, Ohio; Mr. and Mrs. Albert Taxon of the Bronx, New York; Mr. Harry Lee of Short Hills, New Jersey; Mr. and Mrs. Stanley Levine of Long Island City, New York; Dr. Grace G. Eddison of Riverdale, New York; and Mr. and Mrs. George Raeihle of Elmhurst, New York, kindly donated specimens from their private collections. I am particularly indebted to Mr. William E. Old, Jr., of the American Museum of Natural History for technical assistance.

The following abbreviations are used to designate collections of institutions cited in this study:

A.M.N.H., the American Museum of Natural History

C.A.S., the California Academy of Sciences

U.C.M.P., University of California, Museum of Paleontology, Berkeley

U.S.N.M., United States National Museum, Smithsonian Institution

## SYSTEMATIC ACCOUNT

### FAMILY HARPIDAE

#### GENUS *HARPA* RÖDING, 1798

TYPE SPECIES: *Buccinum harpa* Gmelin, 1791 [= *Murex harpa* Linné, 1758 = *H. nobilis* Lamarck, 1816], Recent, Indo-Pacific, by subsequent designation of Winckworth (1945, p. 140).

Although the genus *Harpa* has been credited to several authors, the first valid use of the name appears to date from Röding (1798), predating *Harpa* Lamarck (1799), *Harpalis* Link (1807), and *Harparia* Rafinesque (1815). The name *Harpa* was first used by the pre-Linnean writers

Rumphius and Argenville. However, citations subsequently made by Walch (1771) and Pallas (1774) to these prebinominal authors do not constitute a validation of this taxon. *Cithara* of Klein, not Schumacher (1817), is a pre-Linnean name that has been invalidly applied to this genus.

The family is represented in the American Tertiary by species of the related group *Eocithara*, from the Eocene of California, Mississippi, and Louisiana, but species of *Harpa* (*sensu stricto*) are known only from the Miocene of the Dominican Republic and Mexico, the Oligocene of Peru, and the Pliocene of western Panama. The eastern Pacific species, *Harpa crenata* Swainson (1822), is the sole surviving representative of the family in the Western Hemisphere. A closely related, Recent species, *Harpa doris* Röding (1798), occurs on the west African coast.

The most recent reviews of the extant species of the genus are presented by Melvill (1916) and Maxwell Smith (1948). A detailed study of the anatomy is given by Bergh (1901). Gray (1839, p. 121) described the animal of *Harpa crenata* Swainson, 1822.

### *Harpa (Harpa) crenata* Swainson, 1822

#### Figure 1

*Harpa crenata* SWAINSON, 1822, app. p. 5; 1841, pp. 35, 36, no locality cited. REEVE, 1843, vol. 1, *Harpa* pl. 4, figs. 9a, 9b, 9c, Acapulco, Mexico. STEARNS, 1873, p. 132; "San Juanico, Lower California, Mexico" [? west coast of Baja California]; 1894 [in part], pp. 175, 176, Tres Marías Islands, Mexico. TRYON, 1883, p. 98, pl. 40, fig. 65, Acapulco, [Mexico], and Panama. TOMLIN, 1927, p. 157, Gorgona Island, Colombia. STRONG AND HANNA, 1930, p. 19, Tres Marías Islands, Mexico. PILSBRY AND LOWE, 1932, p. 113, La Paz, Baja California; Tres Marías Islands; Acapulco, Mexico; San Juan del Sur, Nicaragua. STRONG, HANNA, AND HERTLEIN, 1933, p. 119, Acapulco, Mexico. MAXWELL SMITH, 1948, p. 47, pl. 16, fig. 5. KEEN, 1958, p. 431, fig. 663, southern part of Gulf of California to Panama, offshore.

*Harpa scriba* VALENCIENNES, 1832, pp. 323, 324, "portum Acapulco," [Mexico]. CARPENTER, 1857b, p. 171, Acapulco, Mexico, p. 340, Central America.

*Harpa rivoliana* LESSON, 1834 [1832-1835], pl. 36, "Japonica?" [not Japan]. G. B. SOWERBY, II, 1866, p. 171, pl. 232, figs. 12, 13, Acapulco, [Mexico].

*Harpa rosea* Lamarck, KIENER, 1835 [in part], pp. 11, 12, pl. 5, fig. 8, not fig. 8a. Not *Harpa rosea* Lamarck, 1816.

*Harpa rosea crenata* Swainson, GRAY, 1839, p. 122, pl. 34, fig. 5, Pacific Ocean.

TYPE LOCALITY: Of *crenata*, Acapulco, Guerrero, Mexico, here designated; of *scriba*, Acapulco, Guerrero, Mexico; of *rivoliana*, Acapulco, Guerrero, Mexico, here designated.

RANGE: Margarita Island, west coast of Baja California, Mexico (Jordan, 1924); Bahía de Los Angeles, Baja California, Mexico (Boone, 1928); in the Gulf of California, and south to Gorgona Island, Colombia (the

American Museum of Natural History collection); Cocos Island, Costa Rica (Hertlein, 1932).

COLLECTING STATIONS: *Tres Marias Islands, Nayarit*: San Juanito Island, skin diving, 0.5–3 fathoms, two fresh specimens (Station 35); Puerto Bal-leto, María Madre Island, shore collecting, one fresh, beach specimen (Station 34); south of salt works, María Madre Island, shore collecting, four beach specimens (Station 33).

REMARKS: Pilsbry and Lowe (1932) reported beach specimens from

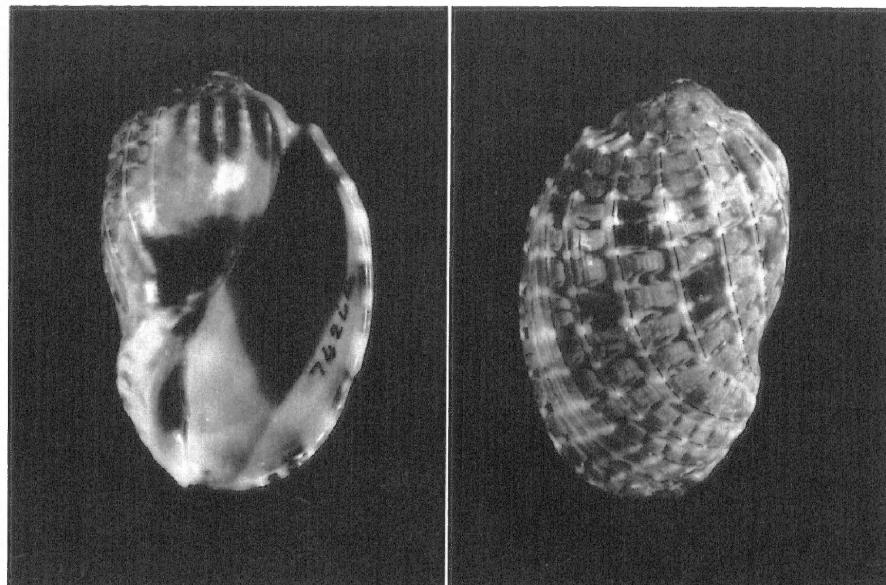


FIG. 1. Small specimen of *Harpa (Harpa) crenata* Swainson, off San Juanito Island, Tres Marias Islands, Mexico (Station 35; A.M.N.H. No. 74264). *Left*: Apertural view. *Right*: Dorsal view.  $\times 1$ .

three west Mexican localities and recorded one specimen containing the animal from the beach at San Juan del Sur, Nicaragua. This species apparently lives in near-shore waters, below wave action. Parker (1963, p. 155, pl. 5) cited living specimens in 11 to 16 fathoms off the coast of Sinaloa, Mexico, in sediments of clay and silt. In the present collection are two specimens, both of which were taken by skin diving in 0.5 to 3 fathoms of water, the shells of which contained decomposing soft parts of the animal. These specimens, neither of which have the spire of the shell preserved, may have been carried into shallow water by a severe storm that preceded our arrival at the Tres Marias Islands (see fig. 1).

Specimens of the present species and the closely related west African

species, *Harpa doris* Röding (1798) [= *Harpa rosea* Lamarck (1816)], are often mislabeled in old collections. The latter species is characterized by having a higher spire, stronger ribs, and by the rose-colored surface.

*Harpa americana* Pilsbry (1922), a species described from the Miocene of Santo Domingo and also known from Miocene deposits in the Tehuantepec area of Mexico (Montoya, 1960), was stated to be very similar to *Harpa doris* Röding, but to have fewer ribs and a narrower aperture. This species is undoubtedly an ancestor of both the living west African and the western American species. *Harpa myrmia* Olsson (1931) is known from the Oligocene Chira formation, near Quercotilla, Peru. Olsson (1942) also recorded an unidentified species of *Harpa* from the Pliocene Charco Azui formation, near Puerto Amuelles, Panama.

*Harpa crenata* is recorded from Pleistocene deposits at Punta Coyote Baja California, Mexico (Hertlein, 1957), and near the Rio Colotepec Oaxaca, Mexico (Palmer and Hertlein, 1936).

It should be noted here that Hertlein and Allison (1960, p. 15) reported several abraded specimens of the Indo-Pacific species, *Harpa gracilis* Broderip and Sowerby, 1829, from Clipperton Island, an isolated coral atoll about 670 miles southwest of Acapulco, Mexico. Inasmuch as many other species of Indo-Pacific mollusks are known to occur at Clipperton Island, this Polynesian species of *Harpa* could be expected to be living on this eastern Pacific atoll.

#### FAMILY VASIDAE

##### SUBFAMILY VASINAE

##### GENUS *VASUM* RÖDING, 1798

TYPE SPECIES: *Voluta turbinellus* Röding, 1798 [= *Voluta turbinellus* Linné, 1758], Recent, Indo-Pacific, by subsequent designation of Winckworth (1945, p. 145). (See Abbott, 1950, p. 209.)

Monographs of the extant species of this genus have recently appeared for the western Atlantic (Abbott, 1950) and the Indo-Pacific (Abbott, 1959) regions. The latter paper gives generic synonymies for the living representatives of the Vasinae.

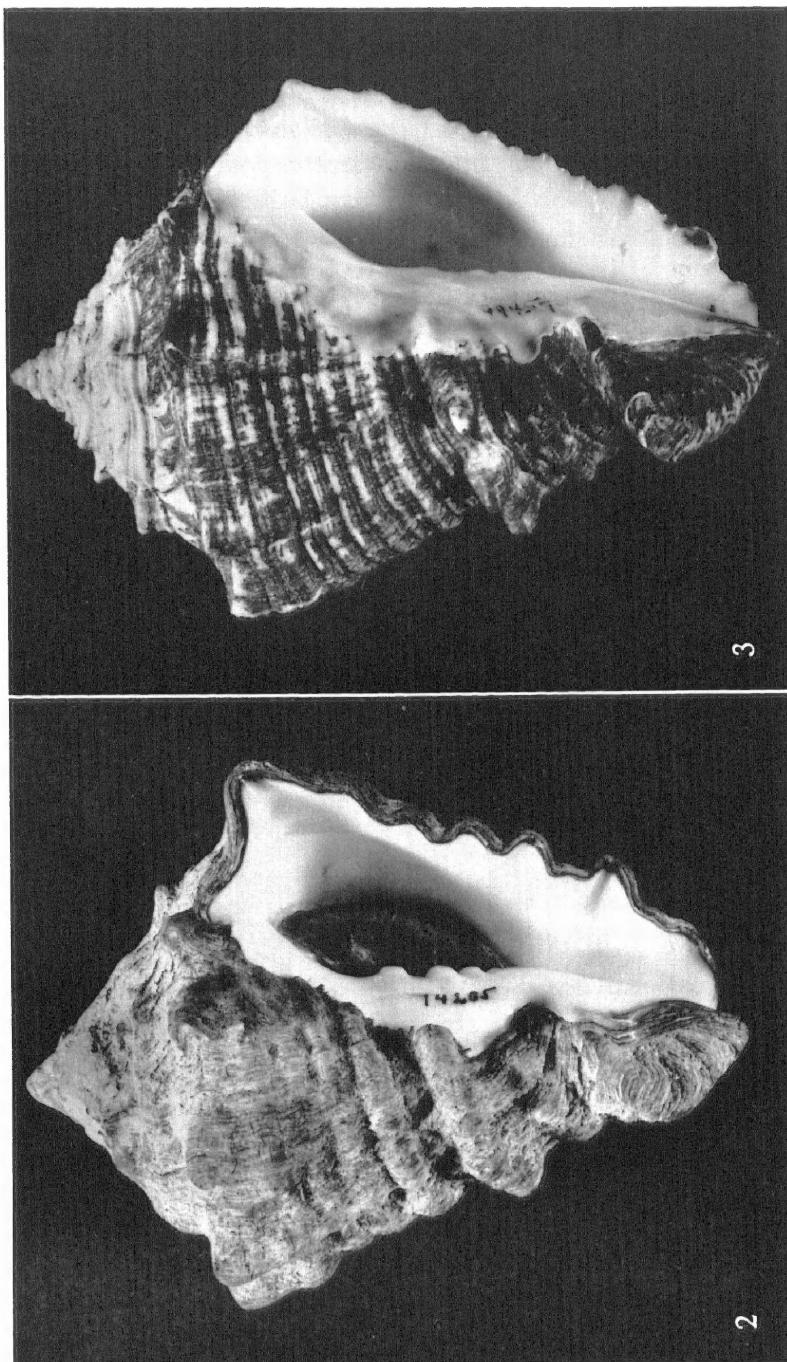
##### *Vasum* (*Vasum*) *caestus* (Broderip), 1833

Figures 2, 4

*Turbinella ardeola* VALENCIENNES, 1832 [ante April], pp. 283, 284, Acapulco, [Mexico]. CARPENTER, 1857a [1855-1857], p. 456; 1857b, pp. 171, 261, 338. TRYON, 1882a, p. 203 [index]. SHERBORN, 1923, p. 442. *Nomen oblitum*.

*Turbinella caestus* BRODERIP, 1833 [May], p. 8, "Caraccas," [Ecuador]. REEVE,

Figs. 2, 3. Apertural views, adults. 2. *Vasum caestus* (Broderip), off María Madre Island, Tres Marias Islands, Mexico (Station 32; A.M.N.H. No. 74205). 3. *Vasum muricatum* Born, Heart Bay, Mayaguez, Puerto Rico (A.M.N.H. No. 99454). Both X 4/5.



1847, *Turbinella* pl. 6, fig. 34a, b, Bay of Caraccas [Bahía de Caráques, Ecuador]. C. B. ADAMS, 1852, pp. 354, 355, Toboga [Island], Panama. CARPENTER, 1857a [1855-1857], p. 456, Mazatlán, [Mexico]; 1857b, p. 338, Gulf of California to Panama.

*Vasum caestus* Broderip, PILSBRY AND LOWE, 1932, p. 113, La Paz, Baja California; Tres Marias Islands; Mazatlan; Manzanillo, Mexico; San Juan del Sur, Nicaragua; and Taboga Island, Panama; "At extreme low tide in sand between rocks." DURHAM, 1950, p. 104, pl. 35, fig. 11, fossil, Baja California, Mexico. KEEN, 1958, p. 432, fig. 664, La Paz, Baja California, Mexico to Panama.

TYPE LOCALITY: Of *V. ardeola*, Acapulco, Guerrero, Mexico; of *V. caestus*, Carácas, Ecuador.

RANGE: Near Guaymas, Sonora, Mexico (Shasky, 1959), in the Gulf of California, and south to Negritos, Peru (Olsson, 1924).

COLLECTING STATIONS: *Tres Marias Islands, Nayarit*: Off San Juanito Island, skiff dredge, 9-11 fathoms, one dead specimen (Station 38); Puerto Balleto, María Madre Island, shore collecting, one beach specimen (Station 27); off María Madre Island, skin diving, 0.5-2 fathoms, two living specimens (Station 32); María Madre Island, shore collecting, one beach specimen (Station 52).

REMARKS: Reeve (1847) discussed in some detail the differences between the present species and its western Atlantic analogue, pointing out that in the eastern American species, *Vasum muricatum* (Born, 1778), the tubercles are more compressed, squamate, and prickly, the furrows are more numerous and less deeply excavated, the columellar plaits number five, i.e., three large and two small intermediately placed ones, instead of four nearly equal plaits, and, finally, the periostracum is lighter brown. Reeve contended that these distinctions occurred in each species throughout all stages of growth, and he presented illustrations of juvenile and adult specimens of both species to exhibit these differences. Tryon (1882a) rejected Reeve's distinguishing characters as being non-diagnostic and placed *Vasum caestus* in the synonymy of *Vasum muricatum*. Abbott (1950), in his monograph of the western Atlantic representatives of the genus, noted some of the morphological distinctions between the two forms and considered the eastern Pacific populations to be merely a subspecies of *Vasum muricatum*. Other students, including Keen (1958), have afforded *Vasum caestus* full specific rank. In order to understand better the taxonomic relationship of the two geographically isolated forms, a study of their fossil records was undertaken.

*Vasum muricatum* (Born) appears to have evolved from Miocene species in the Caribbean area. *Vasum haitensis* (G. B. Sowerby, II, 1850), from deposits on the island of Hispaniola, and *Vasum egonatum* Dall (1890), from the Tampa and Chipola formations of Florida, are similar species that

probably are Miocene ancestors of *Vasum muricatum*, which occurs in deposits of late Pliocene age at Moin Hill, Costa Rica (Gabb, 1881, p. 354; Druid Wilson, *in litt.*). *Vasum floridanum* McGinty (1940), a closely related form, was described from the south side of Ortona Lock, Glades County, Florida, and was cited from the Caloosahatchee marl of Pliocene age.<sup>1</sup> Mr. Wilson (*in litt.*) has informed me that he has collected specimens of *Vasum floridanum* from a number of localities across Florida from unnamed beds that are post-Calosahatchee, pre-Fort Thompson in age (see Kier, 1963, p. 7). These include in place collections from the upper beds at Ortona Lock and Shell Creek. He believes these beds to be correlative with the Pliocene of Moin Hill, Costa Rica. These data, therefore, suggest that *Vasum muricatum* may not have evolved until late Pliocene time.

While several extinct species of *Vasum* (*sensu stricto*) are known from the Cenozoic record of eastern America, only one species has been reported from the Tertiary of western America. The presence, however, of this species, which is apparently more closely related to *Vasum muricatum* than to *V. caestus*, in the Imperial formation of California has paleogeographic significance in demonstrating that a representative of this Caribbean complex had already reached the eastern Pacific by the Pliocene.<sup>2</sup> Moreover, the existence of this species in west America at approximately the same time as, or at possibly an earlier time than, *Vasum muricatum* apparently appeared in eastern America would seem to negate the premise that *V. caestus* is unequivocally a homologue of *V. muricatum*. In an extremely plastic group such as *Vasum*, the modern eastern Pacific populations conceivably could have evolved after the closure of the Central American water gap from a west American congener during Plio-Pleistocene time.<sup>3</sup> The only known fossil occurrences of *Vasum caestus* are from deposits of apparently Pleistocene age at the following localities:

Baja California, Mexico

West coast

Magdalena Bay (Dall, 1918; Jordan, 1936)

Gulf of California

Santa Inez Bay (Durham, 1950; Hertlein, 1957)

<sup>1</sup> It should be noted that a late Pleistocene age recently was suggested by Du Bar (1958a, 1958b) for the Caloosahatchee marl of Florida.

<sup>2</sup> The age of the Imperial formation has been variously dated as late Miocene (Woodring, 1931), early Pliocene (Durham, 1950), or early to late Pliocene (Hanna, 1926). The species of *Vasum* from the Imperial formation is described herein as new.

<sup>3</sup> Witness the apparent appearance and extinction of the *Vasum horridum-lockini* group in the Caloosahatchee marl of Florida (Olsson and Harbison, 1953, pp. 194, 195).

Punta Pulpito (Hertlein, 1957)

Near San Carlos Bay (Emerson *in Squires*, 1959)

Punta San Telmo (Durham, 1950)

Punta Coyote (Hertlein, 1957)

Palmas Bay (Hertlein, 1957)

Coast of Oaxaca, Mexico

Near Rio Colotepec (Palmer and Hertlein, 1936)

Manta, Ecuador (J. P. Smith, 1919; Rivera, 1953)

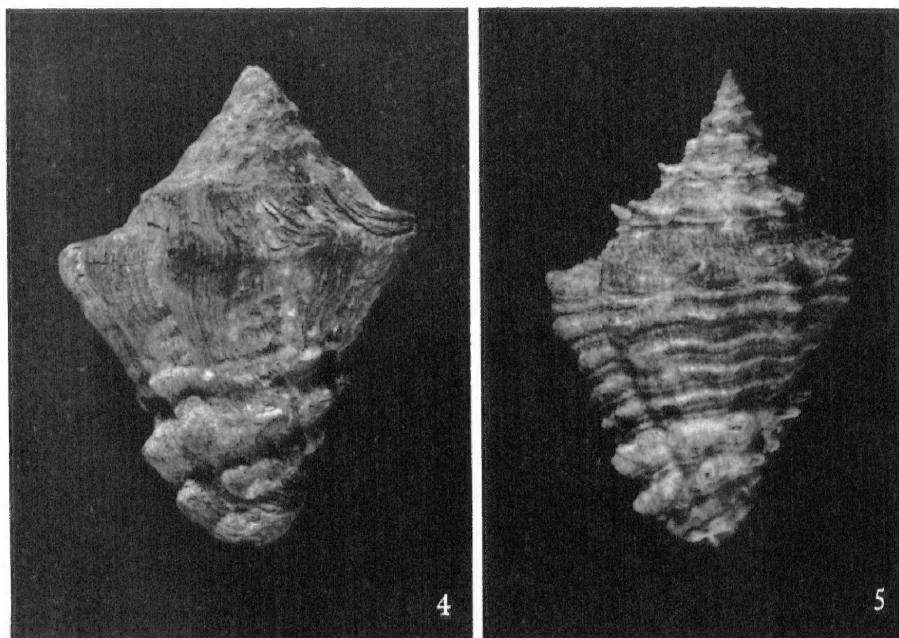


FIG. 4. Dorsal view of small specimen of *Vasum (Vasum) caestus* (Broderip), 5 fathoms, Tangola-Tangola Bay, Mexico (Beebe Station 196-D-14, 15; A.M.N.H. No. 88737).  $\times 1$ .

FIG. 5. Dorsal view of small specimen of *Vasum (Vasum) muricatum* (Born), Puerto Plato, Dominican Republic (A.M.N.H. No. 100965).  $\times 1$ .

The paleontological record appears to lend support to the belief that the conchological characters that serve to distinguish the populations of *Vasum muricatum* and *V. caestus* reflect the presence of two closely related, but distinct species.

Minor differences of the radula of these species also serve to support this conclusion. Drawings of the radular teeth of *Vasum muricatum* recently were given by Abbott (1950, pl. 89, fig. 4) and Warmke (1958, pl. 4, fig. 3). The central tooth of the rachiglossate radula bears three anterior cusps, the central one being about one-third longer than the two cusps

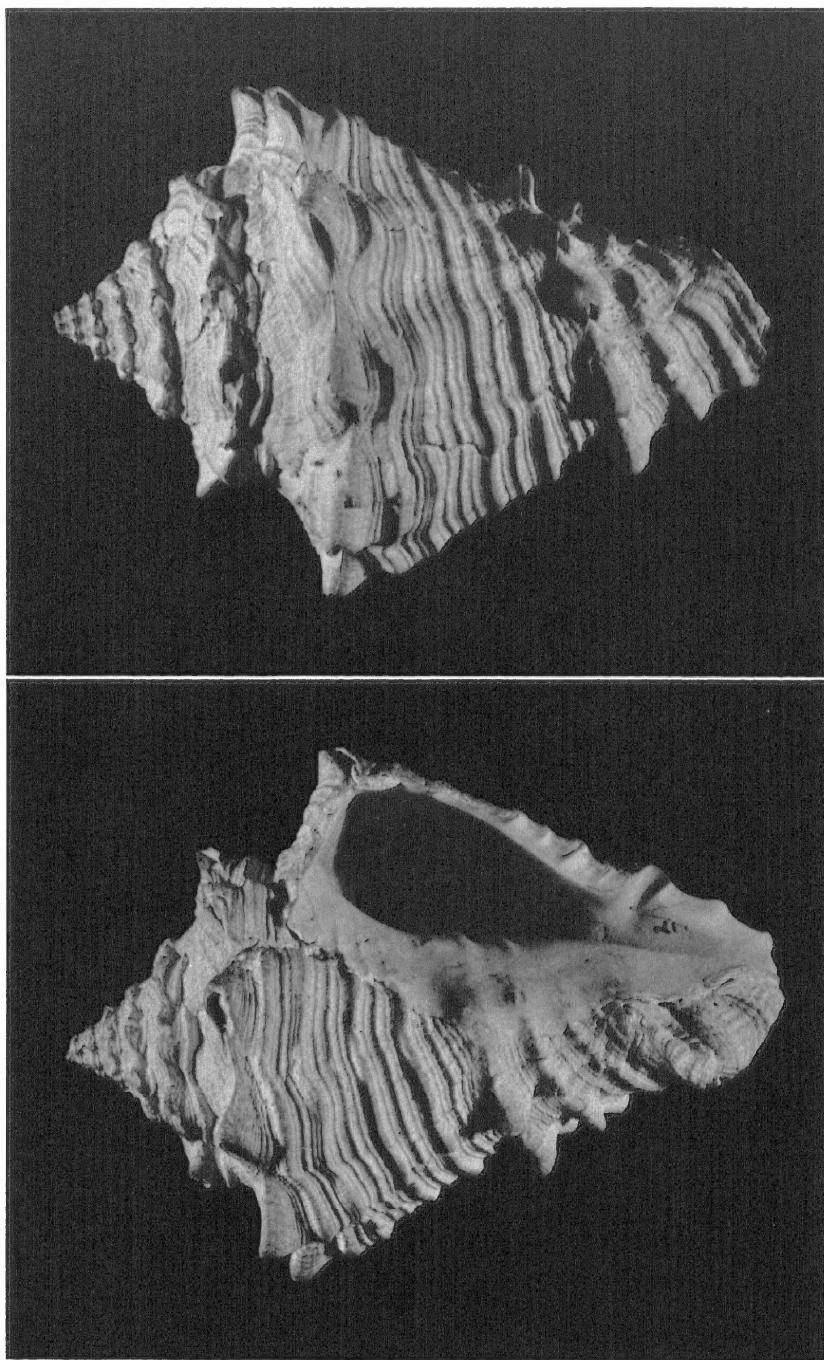


FIG. 6. Holotype of *Vasum (Vasum) floridanum* McGinty, fossil, Ortona Locks, Caloosahatchee Canal, Glades County, Florida (T. McGinty collection). *Left*: Apertural view. *Right*: Dorsal view.  $\times 4/5$ .

that flank the central cusp. The lateral tooth bears two cusps, of which the inner is slightly larger than the outer. In *V. caestus*, however, the central cusp of the central tooth is nearly twice as long as the flanking cusps, and the two cusps of the lateral tooth are more nearly equal in length.

The earliest name for the present species appears to be *Vasum ardeolum* (Valenciennes, 1832), which was based on specimens from Acapulco, Mexico. Carpenter (1857a) correctly applied this name to the present species, but believed that Valenciennes' work dated from 1833 and that this taxon was, therefore, a junior synonym of *Vasum caestus* (Broderip, 1833). This part of Valenciennes' work is now known to have been issued early in 1832 (see Hertlein and Strong, 1955, p. 315). Although Valenciennes' taxon has priority, the present International Code of Zoological Nomenclature states that "A name that has remained unused as a senior synonym in the primary zoological literature for more than fifty years is to be considered a forgotten name" (*nomen oblitum*) and is not to be used unless the International Commission so directs after the matter has been referred to them for consideration (Article 23, b).

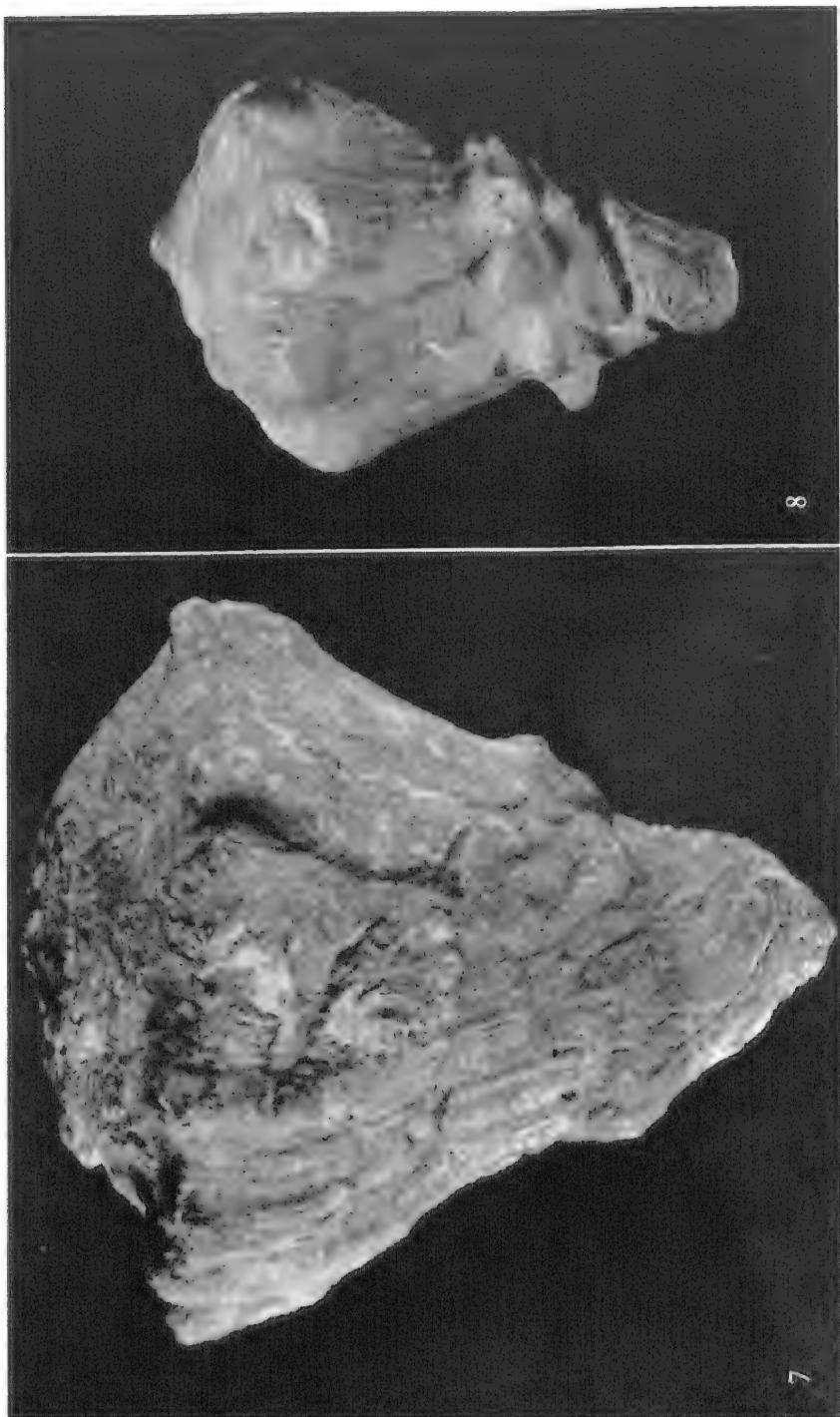
### *Vasum (Vasum) pufferi*, new species

Figures 7, 8

*Vasum caestum* Broderip, HANNA, 1926, pp. 459-460, not *Turbinella caestus* Broderip, 1833.

**DIAGNOSIS:** Shell resembles *Vasum (Vasum) muricatum* (Born, 1778) from the western Atlantic in having the spines on the shoulder of the body whorl hollowed out on the anterior faces, but the shell has finer, more numerous spiral cords on the middle of the body whorl.

**DESCRIPTION:** The adult shell ranges from 63 to 95 mm., is solid and heavy. The whorls are estimated to number eight to nine (spires are lacking), are slightly concave on the sides, and are shouldered with spines that are somewhat intermediate in development between the blunt tubercles formed in *V. caestus* and the more delicate, pointed spines of *V. muricatum* (cf. figs. 4, 5, and 8). In the paratype, there is a ridge below the row of prominent blunt spines near the base of the body whorl. The axial sculpture consists of weakly developed threads, but growth lines are prominent on the body whorl of the holotype. The columellar plaits, according to Hanna (1926, p. 495), number four or five; in the paratype (fig. 8) there are four plaits, arranged in the manner typical for *V. caestus*, i.e., two large plaits and one small plait above the basal plait, which is actually a columellar fold. The umbilicus is moderately developed. The description is based on the holotype and paratype, neither of which, unfortunately, is a complete specimen (figs. 7, 8).



Figs. 7, 8. Dorsal view of *Vasum (Vasum) pufferi*, new species. 7. Holotype, fossil, Carrizo Mountain, Imperial County, California (U.C.M.P. No. 15089). 8. Paratype, fossil, Alverson Canyon, Imperial County, California (C.A.S. No. 2447). Approximately  $\times 1$ .

**REMARKS:** Four specimens of this species were reported under the name of *Vasum caestum* Broderip by Hanna (1926, pp. 459, 460) from the Imperial formation of Imperial County, California. Although no Recent specimens of *V. caestus* were available to Hanna at the time of his study to compare with the fossils from Imperial County, he noted that the fossils had weaker spiral cords on the body whorl than those on the specimens of *V. muricatum* in his possession. After a search of the pertinent collections, I was able to locate only one of the four fossil specimens mentioned by Hanna. This specimen (C.A.S. No. 2447), which I have designated a paratype of this new taxon, and all the specimens I have examined (including the holotype, in addition to a large fragment of a specimen in the Museum of Paleontology, University of California, and two poorly preserved specimens in the Department of Geology, San Diego State College), however, possess very fine, spiral cords. This character serves readily to distinguish this new species from its known American congenitors.

I take extreme pleasure in naming this species in honor of a valued friend and former colleague at the University of California Museum of Paleontology, Elton L. Puffer of San Francisco, California.

**TYPE LOCALITY:** Carrizo Mountain [= Coyote Mountain], Imperial County, California, Imperial formation, Pliocene (U.C.M.P. locality A-1269, "Imperial formation. Southside of Carrizo Mt., in a small canyon about  $\frac{3}{4}$  mile east of mouth of Alverson Canyon. Loc. is small draws [sic] cut in basal conglomerate on west side of canyon, 100-200 yards from its mouth. Loc. in part equals U.C. loc. 738. Bramkamp 1934") (Joseph H. Peck, Jr., *in litt.*, February 19, 1964).

**TYPE DEPOSITORIES:** Holotype, Museum of Paleontology, University of California, Berkeley (U.C.M.P. No. 15089). Paratype, one specimen, the California Academy of Sciences, Department of Geology (C.A.S. No. 2447), from locality 682 ("... the first narrow, box cañon east of Alverson Cañon, Coyote Mountain, Imperial County, California": Hanna, 1926, p. 439).

#### FAMILY VOLUTIDAE

#### GENUS *ENAETA* ADAMS AND ADAMS, 1853

**TYPE SPECIES:** *Voluta harpa* Barnes, 1824 [= *Voluta barnsii* Gray, 1825 = *Voluta barnesii* Gray, Carpenter, 1864, emendation].<sup>1</sup> Recent, eastern Pacific, by subsequent designation of Cossmann (1899, p. 105).

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<sup>1</sup> Not *Voluta harpa* Lamarck, 1811, nor Mawe, 1823 [= *Voluta nucleus* Lamarck, 1811], nor Wood, 1828 [= *Voluta nucleus* Lamarck, 1811], nor Swainson, 1835-1836 [= *Voluta anna* Lesson, 1835].

Hertlein (1957, p. 71) gave a synonymy for this taxon, including type designations, and he discussed the west American species. The genus apparently evolved in warm waters of eastern America and Panama during the Miocene. *Enaeta isabellae* (Maury, 1910) [= *E. americana* (Dall), 1915] occurs in the Chipola formation at Bailey's Ferry, Florida, *E. perturbatrix* (Maury, 1917) is known from the Miocene of Santo Domingo (Pilsbry and Olsson, 1954), and *E. economia* Woodring (1964) is reported from the Gatun formation of Panama. Surviving in the tropical waters of the Caribbean region are four species: *Enaeta archeri* (Angas, 1865), *E. cylleniformis* (Sowerby, 1844), *E. guildingi* (Sowerby, 1844) and *E. reevei* Dall, (1907) [= *Voluta guttata* Reeve, 1849, not Dillwyn, 1817]. No representative of this genus is known from the Tertiary of western North America, and the only living species of the Volutidae that occur at the present time in the eastern Pacific are *Enaeta barnesi* (Gray, 1825), an analogue of *E. archeri*, and *E. cumingi* (Broderip, 1832), which is also known from Pleistocene deposits in the Gulf of California area. *Enaeta economia* (Woodring, 1964, pl. 46, figs. 2, 3) appears to represent the Miocene precursor of *E. barnesi*.

*Enaeta cumingi* (Broderip), 1832

Figure 9

*Voluta Cumingii* BRODERIP, 1832, p. 33, "Gulf of Fonseca, province of San Salvador." G. B. SOWERBY, II, 1847, p. 213, pl. 55, figs. 105-107, Gulf of Fonseca. REEVE, 1849, *Voluta* pl. 1, figs. 1a, 1b, Gulf of Fonseca.

*Lyria (Enaeta) Cumingi* Broderip, ADAMS AND ADAMS, 1853, p. 167. TRYON, 1882b [in part], p. 104, pl. 31, fig. 146, not fig. 147, San Blas, [Nayarit, Mexico], to west coast of Central America.

*Enaeta Pedersenii* VERRILL, 1870, p. 226, La Paz, [Baja California, Mexico]. TRYON, 1882b, p. 104, La Paz.

*Enaeta cumingi* Broderip, DALL, 1907, p. 352, Magdalena Bay, Baja California, Mexico, the Gulf of California, and south to Peru. MAXWELL SMITH, 1942, p. 13, pl. 3, fig. 24, Magdalena Bay, southward to Peru.

*Voluta (Enaeta) cumingii* Broderip, STEARNS, 1894, p. 176, Magdalena Bay, and "San Lucas Cove," latitude 27° 13' N., longitude 112° 05' W., Baja California, Mexico.

*Enaeta pedersenii* Verrill, DALL, 1907, p. 352, La Paz. MAXWELL SMITH, 1942, p. 13, La Paz.

*Enaeta cumingii* Broderip, DURHAM, 1950, p. 104, pl. 32, fig. 5, fossil, Coronados Island, Baja California, Mexico.

*Enaeta cumingii pedersenii* Verrill, HERTLEIN, 1957, p. 72, pl. 13, fig. 14, fossil, Carmen Island, Baja California, Mexico.

*Lyria (Enaeta) cumingii* Broderip, PILSBRY AND LOWE, 1932, p. 113, La Paz, Baja California, Mexico; living on reef. KEEN, 1958 [in part, excluding reference to *Voluta cylleniformis* Sowerby, 1844], p. 432, fig. 666, Magdalena Bay, Baja California, through the Gulf of California, and south to Peru. MCLEAN, 1961, p. 470, Los Angeles Bay, Baja California, Mexico.

*Lyria (Enaeta) pedersenii* Verrill, KEEN, 1958, pp. 432, 433, 552, fig. 667 [fossil from Carmen Island; see Hertlein, 1957], La Paz.

*Lyria pedersenii* Verrill, DU SHANE, 1962, p. 48, Puertecitos, Baja California.

*Enaeta pedersenii* Verrill, WEAVER, 1963, p. 5, "(= *cumingi* Broderip)."

TYPE LOCALITY: Of *cumingii*, Gulf of Fonseca, El Salvador; of *pedersenii*, La Paz, Baja California, Mexico.

RANGE: Magdalena Bay, west coast of Baja California (the California

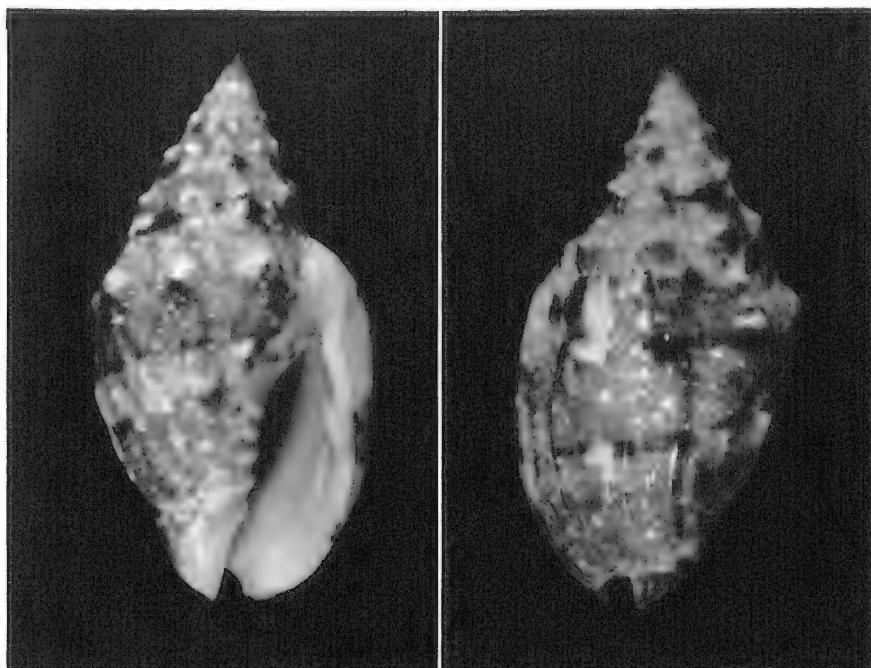


FIG. 9. Adult specimen of *Enaeta cumingi* (Broderip), off Angel de la Guarda Island, Mexico (Station 167; A.M.N.H. No. 77121). Left: Apertural view. Right: Dorsal view.  $\times 2$ .

Academy of Sciences and San Diego Museum of Natural History collections); Puertecitos, Baja California, Mexico (DuShane, 1962), in the Gulf of California, and south to Peru (Dall, 1907).

COLLECTING STATIONS: *Baja California, Gulf coast*: Off Espíritu Santo Island, "Puritan" dredge, 10–12 fathoms, two fresh specimens (Station 96); off Coronados Island, "Puritan" dredge, 13–16.5 fathoms, two fresh, juvenile specimens (Station 144); off San Marcos Island, "Puritan" dredge, 10–11.5 fathoms, one living specimen (Station 151); off southeast end of Angel de la Guarda Island, "Puritan" dredge, 15–17 fathoms, three fresh

specimens (Station 167); off southeast end of Angel de la Guarda Island, "Puritan" dredge, 16–17 fathoms, two fresh specimens (Station 168); Puerto Refugio, Angel de la Guarda Island, "Puritan" dredge, 16–18 fathoms, one living specimen (Station 172); Puerto Refugio, Angel de la Guarda Island, "Puritan" dredge, 17–19 fathoms, two living specimens (Station 173); Gonzaga Bay, shore collecting, two beach specimens (Station 176). *Sonora*: Off south side of Tiburón Island, "Puritan" dredge, 20–22 fathoms, three fresh specimens (Station 160).

**REMARKS:** The radula of the present species was figured by Pilsbry and Olsson (1954, pl. 27, fig. 10) under the name "*Enaeta sowerbyi* Adams (*V. cumingi* Broderip)." Although I have not been able to find any mention of Adams' taxon in the literature, Dr. Harald A. Rehder of the United States National Museum kindly has informed me (*in litt.*) that the radula illustrated by Pilsbry and Olsson was extracted from a "typical" specimen of *E. cumingi* (U.S.N.M. No. 102548).

*Enaeta pederseni* was described without an illustration on the basis of specimens from La Paz that Verrill (1870, p. 226) believed to be more slender, with a more acute spire, a more prolonged and recurved siphon, to have a more contracted aperture and a smoother and lighter-colored surface ornamented by smaller tubercles and costae than *Enaeta cumingi* (Broderip). Specimens approaching this description have been illustrated by G. B. Sowerby, II (1847, pl. 55, fig. 107), from the Gulf of Fonseca, by Durham (1950, pl. 32, fig. 5) from the Pleistocene of Coronados Island in the Gulf of California, and by Hertlein (1957, pl. 13, fig. 12) from the Pleistocene of Santa Inez Bay, also in the Gulf of California. An examination of the present specimens indicates that the conchological characters used by Verrill to distinguish his taxon from that of Broderip are extremely variable. All the characters cited by Verrill are observable in the large samples at hand, and the present study suggests that *Enaeta pederseni* Verrill is merely an infrasubspecific form of *E. cumingi* (Broderip). This conclusion was reached by Stearns (1894, p. 176) many years ago.

This species is also known from the Pleistocene of Magdalena Bay, on the west coast of Baja California (Dall, 1918; Jordan, 1936).

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